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The Development of Coal Mining

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Probably the earliest mention of coal on record was about 371 B. C., when Theophrastus, a pupil of Aristotle, mentioned in a treatise "On Stones," fossil substances "that are called coals, which kindle and burn like wood coals." "These are found in Liguria and in Elis, in the way to Olympias, over the mountains; they are used by the smiths."

In England coal has been mined and sold as an article of commerce since A. D. 1215, and it was here that the first great development in coal mining took place.

The first mining was doubtless simple digging of the coal where actually exposed at the surface of the ground. In early times, in districts where comparatively few feet of overlying strata covered the coal, small holes or shafts, three or four feet in diameter, were put down to the seam and then widened out, so as to allow of the excavation of as much coal as possible without causing the upper strata to fall in. These are known as "bell pits."

In the fourteenth century coal was mined in England by shaft and adit, the adit being a horizontal tunnel driven from the surface on some hillside at such a level as to drain off the water from the workings. The coal was hoisted up the shaft by a common winch moved by manual labor, or by men or women carrying it on their backs up ladders. Narrow passages were driven in the coal seam, leaving small pillars to support the roof. When difficulties arose from want of air, from too much water, or from crush of strata, the shaft was abandoned and a new one sunk not far off, the depth being not more than that of many of the hand-dug wells now found in this country. In this mining one shaft was sunk for every 10 or 11 acres.

During the fifteenth, sixteenth and seventeenth centuries few improvements of importance were introduced.

The invention of the atmospheric engine (the first application of steam in an engine) by Thomas Newcomen of Dartmouth, England, in 1710, changed the whole aspect of the industry. At that time 350 feet was about the maximum depth of shafts, and their diameter seven to eight feet, and the area worked to one shaft was seldom more than 200 yards radius round the shaft. Fifty years later Walker Colliery, on the Tyne, England, was sunk a depth of 600 feet to the coal, and in 1763 a pumping engine was erected there, having a cylinder 72 inches in diameter and 10½ feet long. The steam engine was first applied to hoisting coal out of the mine in 1780.

Deeper shafts and more extensive areas of workings introduced serious problems in ventilation and illumination and brought in the era of big explosions, which era is even now not ended. The number of such explosions has been much lessened in recent years by the development and

use of larger and more efficient ventilating fans and by the use of safer and better means of illumination.

As regards the working of the coal, it was early discovered that vertical planes of cleavage (the face and the butt cleavage) run through the seams in two directions at approximately right angles to each other, and that one of these, the face cleavage, is more pronounced than the other. Passageways can be most easily driven at right angles to the main or "face" cleavage. Advantage was taken of this in mining early in the eighteenth century, and led to what is known as the Bord and Pillar system of mining in England and a somewhat similar system called the Room and Pillar system in this country.

The commercial mining of coal in the United States dates from early in the nineteenth century. The early workings were on what is known as the Single Entry Room and Pillar system. (See Fig. 1.) This consisted of an entry or passageway 8 to 10 feet wide in the seam, usually driven parallel to the main or face cleavage. From this entry wider passageways called rooms, from which most of the coal was mined, were driven at right angles. The air for ventilation was circulated as indicated by the arrows. By this method probably about 40% of the coal was extracted, the remaining 60% being left as pillars to support the overlying strata.

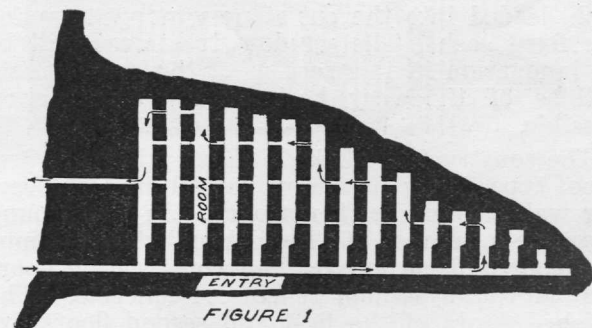


FIGURE 1

As mining developments became more extensive it became increasingly difficult to adequately ventilate a large mine operated on the Single Entry Room and Pillar system. This led to the development of what is known as the Double Entry Room and Pillar system of mining. (See Fig. 2.) In this system the single entry has been replaced by two parallel entries with rooms driven at right angles off the entries. A complete mine layout consists of main entries in pairs from which cross entries are driven every 300 to 500 feet. The rooms are driven off the cross entries and parallel to the main entries. The entries are thus laid out much like the streets of a city. In some of our larger mines, frequently several miles in extent, it has been found necessary to drive as many as three, four, or even five entries side by side to allow adequate ventilation and transporta-

tion facilities. This is the system of mining now used in most of the coal mines of the United States, although modified considerably at places to meet local conditions. The percentage of recovery is usually not over 65 to 70%, although as much as 90% is claimed in some places where the pillars are mined.

Another system of coal mining considerably used in Europe and to a much lesser extent in the United States is the so-called "Long Wall" system. In this system the coal is mined in one long wall or face. All coal is removed and the strata allowed to fall behind the miner. The "Long Wall" system recovers a high percentage of the coal but natural conditions are not favorable to its general introduction in this country.

The cycle of operations as developed in coal mining was as follows: The miner first undercut the coal to a depth of about three feet with a pick. He next broke the coal down by means of wedges and bars; then shoveled it into small cars or wagons and pushed or trammed these loaded cars to the shaft bottom or to the surface, if the mine had a horizontal opening. As engineering knowledge advanced, mechanical means were found to perform various steps in this cycle of operations.

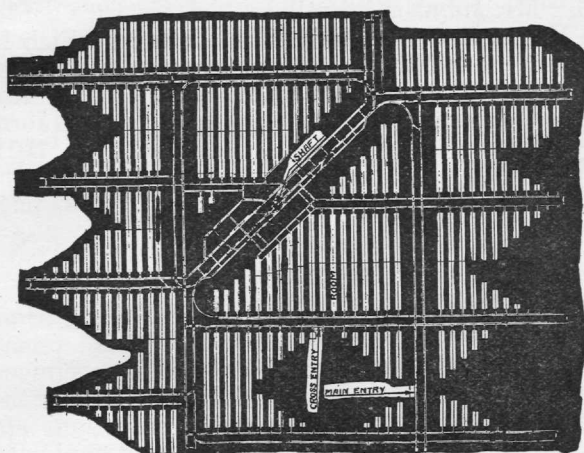


FIGURE 2

The wedge for breaking down the coal was long since replaced by explosives; the loaded cars were no longer pushed out by the miner, but a horse or mule was used, and in more recent years electric or compressed air locomotives have in a large measure replaced the horses. The last 50 years have seen rapid strides in the development and use of mining machinery. Most of the coal is now undercut by machinery. In fact, undercutting by pick is rapidly becoming a lost art. In more recent years some mines are even using shoveling machines to shovel the coal into the mine cars. An effort has also been made to use mechanical conveyors to transport the coal from the mining face.

A careful examination of the present mechanical equipment in coal mines shows that most of the machinery has been developed to perform some one operation in the cycle of operations mentioned above, and this cycle of operations was developed to meet the needs of the Room and Pillar system of mining. It is probable that we have about reached the limit of development in machinery with the Double Entry, Room and Pillar sys-

tems of mine layout. The operation of machinery under this system is necessarily intermittent. First, a machine is brought into a room and the coal is undercut; then the machine is moved to another room; next the holes are drilled, charged with explosive and the coal shot down; then it is shoveled, either by hand or machine, into the cars. The operation is interrupted each time a car is loaded until it is hauled from 50 to 500 feet and another empty car brought in.

Recently attempts have been made to introduce machines that perform the complete cycle equivalent to undercutting the coal, shooting it, and loading it into cars; in short, to mine the coal. These machines have not been as successful as was hoped, largely due to the fact that they have been tried out in a system of mining in which their operation was intermittent instead of continuous.

In the Room and Pillar system of mining it is impossible to keep any mining machine busy continuously as only one car can be gotten to the machine at a time and only a limited amount of work can be done in one room until ventilation requirements, etc., make it necessary to move to the next room.

It is a well recognized fact that in order to make investments in machinery pay, such machinery must be kept in operation practically continuously at near its rated capacity. Some recently published figures show that mining machines in practice are showing a performance of from 25 to 35% of their capacity, due to the large amount of time spent in waiting for cars and in moving from place to place in the mine. This figure can probably not be materially improved with the present mine layout, which was developed to suit the needs of hand mining.

Right here the young mining engineer has a great opportunity. The day is coming when, instead of trying to adopt the machine to the present mining system, we will re-design our mine layout so that machinery can be used both efficiently and safely. I do not believe it will be many years before the entire cycle of coal mining operations, including transportation, will be done by machinery operated efficiently. Bringing this to pass is one of the large tasks now confronting the mining engineer, and the young man who faces the problem with an open mind unprejudiced and untrammelled by traditions has a great opportunity before him.

DIDN'T CARE TO MENTION HIS NAME

A colored woman presented herself the other day in an equal suffrage state at the place of registration to qualify for the casting of her vote upon the school question at the next election.

"With what political party do you affiliate?" inquired the clerk of the unaccustomed applicant, using the prescribed formula.

The dusky "lady" blushed, all coyness and confusion. "Is I 'bleeged to answer that there question?"

"Certainly, the law requires it."

"Then," retreating in dismay, "I don't believe I'll vote, 'case I'd hate to have to mention the party's name. He's one of the nicest gentl'muns in town."—Ladies' Home Journal.